

CLAIMS:

1. A method of making a heat treated coated article, the method comprising:
providing a coating supported by a glass substrate, the coating comprising a layer comprising zirconium nitride and a layer comprising hydrogenated diamond-like carbon (DLC) provided over at least the layer comprising zirconium nitride;
heat treating the glass substrate and the coating in a manner sufficient for thermal tempering, heat strengthening and/or heat bending the glass substrate; and
wherein during said heat treating the layer comprising hydrogenated DLC is subject to combustion or burns off so as to generate heat sufficient to cause the layer comprising zirconium nitride to transform into a heat treated layer comprising zirconium oxide in the heat treated coated article.
2. The method of claim 1, wherein the heat treated layer comprising zirconium oxide comprises a nanocrystalline cubic lattice structure.
3. The method of claim 1, wherein the heat treated layer comprising zirconium oxide comprises from about 30-80% oxygen.
4. The method of claim 1, wherein the heat treated layer comprising zirconium oxide comprises from about 50 to 70% oxygen.
5. The method of claim 1, wherein the heat treated layer comprising zirconium oxide comprises from about 20-60% Zr.
6. The method of claim 1, wherein the heat treated layer comprising zirconium oxide comprises from about 30-55% Zr.
7. The method of claim 1, wherein the heat treated layer comprising zirconium oxide comprises from about 30-45% Zr and from about 0-10% N.

8. The method of claim 1, wherein the heat treated layer comprising zirconium oxide includes Zr_xO_y , wherein y/x is from about 1.2 to 2.5.
9. The method of claim 1, wherein the heat treated layer comprising zirconium oxide includes Zr_xO_y , wherein y/x is from about 1.4 to 2.1.
10. The method of claim 1, wherein during the heat treating the layer comprising zirconium nitride is heated to a temperature higher than a temperature used by a heat treating furnace due to combustion of the layer comprising DLC, so as to allow the heat treated layer comprising zirconium oxide to grow at least partially in cubic form.
11. The method of claim 1, wherein the coated article prior to the heat treating comprises an additional layer comprising DLC and an additional layer comprising zirconium nitride.
12. The method of claim 1, wherein the heat treated coated article includes at least one dielectric layer and/or at least one layer comprising DLC located between the glass substrate and the layer comprising zirconium oxide.
13. The method of claim 12, wherein the dielectric layer comprises silicon oxide and/or silicon nitride.
14. The method of claim 1, wherein the heat treated layer comprising zirconium oxide consists essentially of zirconium oxide.
15. The method of claim 1, wherein the heat treated coated article is scratch resistant and has a critical scratch load using an alumina sphere of at least about 20 lbs.

16. The method of claim 1, wherein the layer comprising zirconium oxide is an outermost layer of the heat treated coated article.

17. The method of claim 1, wherein visible transmission % of the coated article increases by at least 30% due to the heat treating.

18. The method of claim 1, wherein visible transmission % of the coated article increases by at least 40% due to the heat treating.

19. The method of claim 1, wherein the heat treated coated article comprises, from the glass substrate outwardly, the following successive layers: a dielectric layer, a layer comprising DLC, and the layer comprising zirconium oxide.

20. The method of claim 1, wherein the heat treated coated article has a transmissive a^* value of from -4 to 0 , and a transmissive b^* value of from -3 to $+3$.

21. The method of claim 1, wherein the heat treated coated article has a visible transmission of at least 60%.

22. The method of claim 1, wherein the heat treated coated article has a visible transmission of at least 75%.

23. The method of claim 1, wherein the heat treated layer comprising zirconium oxide is at least 10% thicker than the layer comprising zirconium nitride which was not heat treated.

24. The method of claim 1, wherein the heat treated layer comprising zirconium oxide is at least 40% thicker than the layer comprising zirconium nitride which was not heat treated.

25. The method of claim 1, wherein the layer comprising DLC includes from 5 to 30% hydrogen.

26. The method of claim 1, wherein the layer comprising DLC comprises sp^3 carbon – carbon (C - C) bonds and has an average density of at least about 2.4 gm/cm³.

27. The method of claim 1, wherein the layer comprising DLC is not present in the heat treated coated article, as it burned off during said heat treating.

28. The method of claim 1, wherein the layer comprising DLC was the outermost layer of the coated article before the heat treating.

29. The method of claim 1, wherein the glass substrate includes a base glass portion comprising:

SiO ₂	at least 67 %
Na ₂ O	10 to 20%
CaO	5 to 15%
MgO	0 to 8%
Al ₂ O ₃	0 to 5%
K ₂ O	0 to 5%

and a colorant portion comprising:

total iron (expressed Fe ₂ O ₃):	0.01 to 0.20%
cobalt oxide:	0.1 to 15 ppm
chromium oxide:	0 to 10 ppm
titanium oxide:	0 to 0.5%
glass redox:	<= 0.10
%FeO:	0.0001 to 0.05%

and wherein the glass substrate with no coating thereon has a visible transmission of at least about 85%.

30. A method of making a heat treated coated article, the method comprising:

providing a coating supported by a glass substrate, the coating comprising a layer comprising a metal nitride and a layer comprising diamond-like carbon (DLC) provided over at least the layer comprising the metal nitride;

heat treating the glass substrate and the coating; and

wherein, during the heat treating, the layer comprising DLC is subject to combustion or burns off so as to cause the layer comprising the metal nitride to transform into a heat treated layer comprising an oxide of the metal in the heat treated coated article.

31. The method of claim 30, wherein the heat treated layer comprises a nanocrystalline cubic lattice structure, and wherein the layer comprising the metal nitride did not include a cubic lattice structure prior to the heat treating.

32. The method of claim 30, wherein the metal comprises Zr.

33. A heat treated coated article including a coating supported by a glass substrate, the coating comprising:

an outermost layer comprising nanocrystalline zirconium oxide comprising cubic lattice structure; and

wherein the layer comprising zirconium oxide further comprises from 0.25 to 20% carbon.

34. The heat treated coated article of claim 33, further comprising a layer comprising DLC between the layer comprising zirconium oxide and the glass substrate.

35. The heat treated coated article of claim 33, wherein the layer comprising zirconium oxide further includes from 1-5% nitrogen.

36. The heat treated coated article of claim 33, wherein the coated article has a visible transmission of at least 75% and a critical scratch load using an alumina sphere of at least about 20 lbs.

37. The heat treated coated article of claim 33 wherein the coated article has a critical scratch load using an alumina sphere of at least about 22.5 lbs.

38. The heat treated coated article of claim 33 wherein the coated article has a critical scratch load using an alumina sphere of at least about 30 lbs.

39. The heat treated coated article of claim 33, wherein the layer comprising zirconium oxide comprises from 0.25 to 10% carbon.

40. The heat treated coated article of claim 33, wherein the layer comprising zirconium oxide comprises from 0.25 to 5% carbon.

41. A coated article including a coating supported by a glass substrate, the coating comprising:

an outermost layer comprising zirconium oxide; and

wherein the layer comprising zirconium oxide further comprises from 0.25 to 20% carbon.

42. The heat treated coated article of claim 41, wherein the layer comprising zirconium oxide comprises from 0.25 to 5% carbon.

43. A coated article including a coating supported by a glass substrate, the coating comprising from the glass substrate outwardly:

a layer comprising zirconium nitride; and

a layer comprising hydrogenated diamond-like carbon (DLC).

44. The coated article of claim 43, wherein the layer comprising DLC contacts the layer comprising zirconium nitride.

45. The coated article of claim 43, wherein the layer comprising DLC is a sacrificial layer adapted to burn off during heat treatment.

46. The coated article of claim 43, further comprising at least one dielectric layer located between the glass substrate and the layer comprising zirconium nitride.

47. The coated article of claim 43, wherein the coating comprises at least two sets of alternating layers comprising DLC and zirconium nitride.

48. The coated article of claim 43, wherein the coated article is not heat treated.

49. A method of making a coated article, the method comprising:
providing a coating supported by a substrate, the coating comprising a layer comprising diamond-like carbon (DLC) and a layer to be phase-transformed during heat treatment;

heating the layer comprising DLC and the layer to be phase-transformed in order to cause combustion of the layer comprising DLC thereby causing the layer comprising DLC to generate heat upon combustion thereof; and

using heat generated by combustion of the layer comprising DLC to help phase-transform the layer to be phase-transformed so that a new phase-transformed layer is formed.

50. The method of claim 49, wherein the layer to be phase-transformed and the new phase-transformed layer each comprise Zr.

51. The method of claim 49, wherein phase-transformation of the layer to be phase-transformed comprises at least one of : (a) changing from a nitride based layer to an oxide based layer; and (b) changing a molecular, bonding, and/or crystallinity structure of at least part of the layer.

52. The method of claim 49, wherein during the heating the layer to be phase-transformed is heated to a temperature higher than a temperature used by a heat treating furnace due to combustion of the layer comprising DLC, so as to allow the

new phase-transformed layer to grow at least partially in cubic and/or crystalline form.

53. The method of claim 49, wherein the layer comprising DLC comprises from 5 to 30% hydrogen.

54. A method of making a coated article, the method comprising:
providing a coating supported by a glass substrate, the coating comprising a combustible layer and a layer comprising at least one of: (a) Zr, and (b) a metal nitride, to be phase-transformed during heat treatment;
heating the combustible layer and the layer to be phase-transformed in order to cause combustion of the combustible layer thereby causing the combustible layer to generate heat upon combustion thereof;
using heat generated by combustion of the combustible layer to help phase-transform the layer comprising at least one of: (a) Zr, and (b) a metal nitride, so that a new phase-transformed layer is formed; and
wherein the new phase-transformed layer comprises at least one of (i) zirconium oxide, and (ii) a cubic lattice structure.

55. The method of claim 54, wherein the combustible layer comprises hydrogenated diamond-like carbon (DLC).